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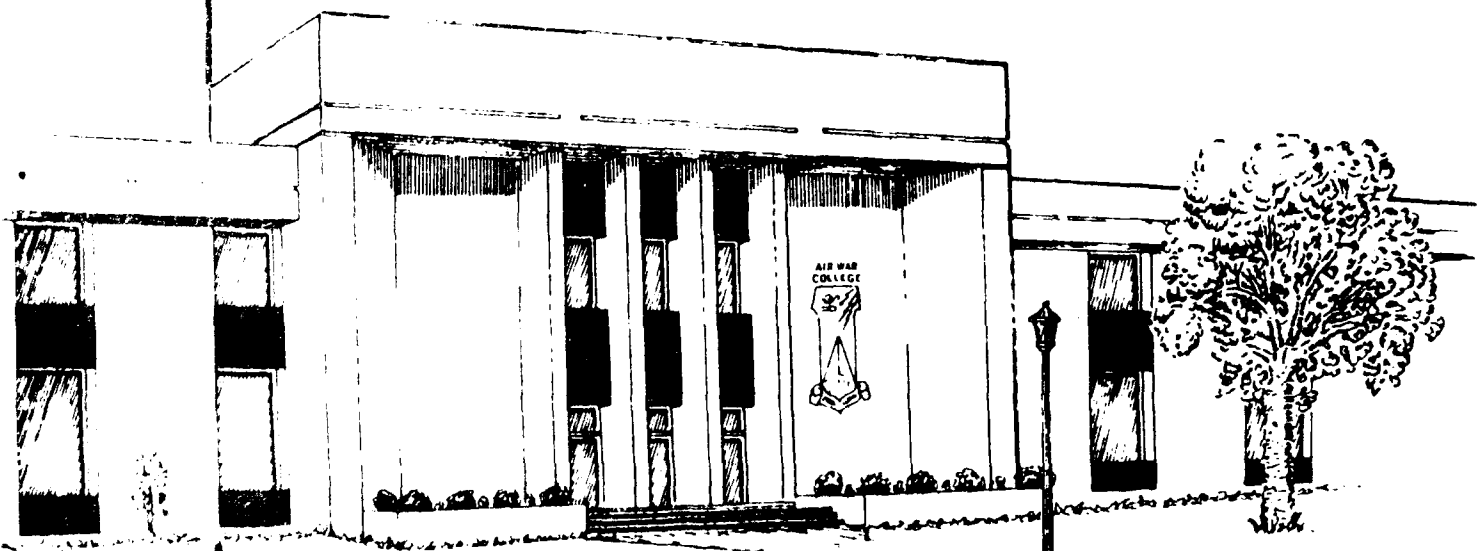
AN AIR FORCE GROUND ATTACK CONTROL CAPABILITY
TO SUPPORT AIRLAND BATTLE

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1990



AIR UNIVERSITY
UNITED STATES AIR FORCE
MAXWELL AIR FORCE BASE, ALABAMA

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AN AIR FORCE GROUND ATTACK CONTROL CAPABILITY
TO SUPPORT AIRLAND BATTLE

by

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A DEFENSE ANALYTICAL STUDY SUBMITTED TO THE FACULTY
IN
FULFILLMENT OF THE CURRICULUM
REQUIREMENT

Advisor: Colonel Bryant P. Culberson

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EXECUTIVE SUMMARY

TITLE: An Air Force Ground Attack Control Capability to Support AirLand Battle

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The Air Force is tasked to provide air interdiction and battlefield air interdiction support to the land component commander. However, the Air Force is limited in executing this tasking by the inability to see and detect ground targets and the inability to control and execute the missions.

This study examines the joint battlefield tactical environment to determine what is required to improve the Air Force command and control contribution to AirLand Battle. Building on this approach, the author analyzes the ground attack control capability concept to determine if it will significantly enhance the present tactical air control system (TACS) capability to conduct effective command and control of TACAIR operations in support of AirLand Battle doctrine.

Finally, the author examines three options available to the Air Force that will give the TACS the capability to receive, process and disseminate second echelon follow-on forces enemy target data. Based on this analysis, the author determines which system integration approach will optimize the GACC concept and enhance command and control of TACAIR.

BIOGRAPHICAL SKETCH

Lieutenant Colonel Bobby W. Smart (B.S., Management, University of Alabama, M.M.A.S., United States Army Command and General Staff College) has been involved with the tactical air control system since 1972. He served in Southeast Asia as an air weapons controller. Following this tour he was assigned to Camp Pendleton, California where he was the joint service Project Coordination Officer for automated tactical air control system (TACS) software design improvements. It was here that he first became interested in systems improvements for the TACS. He has held positions in training and standardization/evaluation at the Wing level and worked in the Directorate of Command and Control at HQ TAC. He has had two tours as a commander in the TACS, one in the Tactical Air Command and one in United States Air Forces Europe. Lieutenant Colonel Smart is a graduate of the Air War College, class of 1990.

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CHAPTER I

INTRODUCTION

Historical Perspective

"Readiness is our Profession." This statement, the motto of the Tactical Air Command (TAC), emphasizes the importance of preparedness for war. However, the changing nature of the battlefield environment, and the impact of improved technology on modern warfare make preparedness a challenging and often elusive goal.

The challenge of how to employ and control air power had its beginning with World War I. During this period, the airplane added a new dimension to the battlefield. With this capability came speed, range, firepower, and flexibility. Yet, there were problems with how to effectively employ the capability. The period between 1920 and 1941 saw tremendous improvements in aircraft capabilities, radar, and communications techniques. "However, the United States was yet to develop a system to effectively command and control tactical aircraft in the demanding and dynamic changing tactical environment." (1:11)

World War II found the U.S. unprepared in the area of air employment. The Tunisian Campaign and the battle at Kasserine Pass highlighted this serious deficiency. The Allied forces were far superior; yet, they were defeated by a numerically inferior German Air Force. The Allied forces had no command and control structure with centralized control of air assets. The Germans, on the other hand, centralized control of air assets and brought them to bear

with effective and decisive results.

By the end of World War II the U.S. had learned from their mistakes. A basic tactical air control system (TACS) structure had been developed, and radar was being used to control aircraft and provide early warning of enemy air attacks. This system continued to evolve during the Korean and Vietnam wars and has changed over time to meet operational requirements.

The United States military has faced many problems as air power concepts have evolved and technology has improved. Today's battlefield is a complex environment where sophisticated weapons systems are employed to wage warfare. A system that is considered state-of-the-art today may be technologically obsolete in a few short years. These dynamics highlight the challenge today's military leaders face in keeping pace with expanding technology and the changing threat.

As technology has evolved, warfighting methods have changed. This change in the approach to warfare has necessitated a closer integration of air and land forces. History has proven that ground elements in warfare will be affected by supporting air operations. Examples include the neutralization of the Luftwaffe during the Normandy invasion, and the affect air power had on the German attack in the Ardennes in 1944.

The realization that future warfare will require close coordination between services, coupled with advances in technology, has forced military strategists to take a more realistic view of the battlefield. Today the Army's view of

warfare has shifted from a linear, attrition-style battle to a more fluid battle fought in depth. The emphasis today is on maneuver and is designed to capitalize on improved firepower and mobility. However, it is important to note that this change in focus has not been without many challenges. Army forces must be able to fight as part of a joint team with units of the Air Force, Navy and Marine Corps. In addition, the Army must be prepared to fight an enemy across the full spectrum of warfare -- high, mid and low intensity conflicts. Finally, future conflicts will extend across a wider space of air, land and sea than previously experienced. (12:2)

Today the Army has started to take a big picture view of the battlefield -- a "theater of operations" approach. This change in focus has evolved into a new doctrine: AirLand Battle doctrine. (12:14) One of the key roles of the Air Force in support of AirLand Battle doctrine is to provide support to the ground commander. (10:2-15) How to best accomplish this task has been a matter of debate and controversy since the early stages of AirLand Battle doctrine development.

One of the elements of AirLand Battle is deep attacks against second echelon enemy forces -- a "follow-on forces" attack strategy. (12:19) This strategy is designed to stop second echelon forces from moving up into the combat zone. Army Field Manual (FM) 100-5, Operations, dated May 1986 expresses this broader view and states what the Air Force can do to put "air" in AirLand Battle. "Tactical air force missions which contribute most directly to land operations

are counter air, air interdiction, close air support, special operations, and surveillance and reconnaissance." (12:48)

The Air Force is tasked to provide close air support (CAS), air interdiction (AI), and battlefield air interdiction (BAI) support to the land component commander. However, the Air Force is limited in executing this tasking by the inability to see and detect ground targets and the inability to control and execute the missions.

To correct these limitations, the Tactical Air Forces (TAF) developed a statement of operational need (SON) for a ground attack control capability (GACC). This concept is envisioned to provide an air-to-surface capability in the air interdiction and battlefield air interdiction structure like the air-to-air capability currently provided by the air defense structure. Within the air defense structure, the control and reporting center (CRC) has for years used ground and airborne sensors to detect and provide timely information on air targets. The GACC concept describes the need for an operations control function and capability dedicated to planning and controlling attacks against time sensitive, ground targets designated by the tactical air control center (TACC).

Purpose

The purpose of this study is to determine if a ground attack control capability, will significantly enhance the present tactical air control system (TACS) capability to conduct effective command and control of TACAIR operations in support of AirLand Battle doctrine. If so, what systems

integration approach will optimize the ground attack control capability concept and enhance command and control of TACAIR?

Background

"A USAF Tactical Air Control System is the organization, personnel, procedures, and equipment necessary to plan, direct, and control tactical air operations and to coordinate air operations with other Services and Allies forces. It is composed of control agencies and communications-electronics facilities that provide the means for centralized control and decentralized execution of tactical air operations." (11:5-1)

The tactical air control system (TACS) provides the Tactical Air Forces (TAF) Commander with the capability to direct and control tactical air assets. The system is highly flexible and may be employed in support of a unified command, Joint Task Force (JTF), as an augmentation resource or as an independent element. This flexibility enables the tactical air control system to be easily adapted to meet changing tactical situations and employed across the full spectrum of conflict. (9:3-8)

The mission of a deployed TACS is to provide the TAF commander with the means to centrally plan, direct, and control tactical air operations, and integrate USAF air operations with the operations of other service components and allies.

This broad notional tasking requires a standardized TACS structure; therefore, this study will address tactical air control system operations and support as they apply to a

CONUS based TACS with a worldwide mission tasking. However, the conclusions derived from this study may have applicability to all operational theaters.

Methodology

This study addresses the nature and scope of systems interfaces that will be required to improve the display and exchange of enemy ground target information between the Air Force and Army command and control elements during planning and execution of TACAIR missions. To accomplish this task, the study will examine the joint battlefield environment and determine what is required to improve the Air Force command and control contribution to AirLand Battle. As part of this effort, the study will look at three programs that may have the potential to enhance the Air Force contribution to AirLand Battle.

Chapter II examines the current tactical command and control structure. This includes a discussion of the relationship and mission of the various ground surveillance and control elements of the TACS. This chapter also examines the current system's deficiencies.

Chapter III examines the current tactical command and control environment. It includes a discussion of the Air Force contribution to AirLand battle and the role of TACAIR in offensive operations. Future systems that will operate on the AirLand battlefield are also discussed.

Chapter IV includes a historical view of TACS modernization initiatives. This section addresses planned modular control equipment (MCE) capabilities as well as postulated ground attack control capabilities. An Army and

Air Force system architecture that will support the ground attack mission is examined, and three approaches to implementing an Air Force ground attack control capability are discussed.

Chapter V evaluates the effectiveness of today's tactical air control system in executing AirLand Battle doctrine. Next the ground attack control capability contribution to AirLand Battle is analyzed. The results of this analysis are used to determine if a ground attack control capability will significantly enhance the present tactical air control system's capability to conduct effective command and control of TACAIR. Based on this finding, a proposed solution is presented that optimizes the Air Force contribution to AirLand Battle.

Assumptions

Four assumptions are essential in an analysis of the TAF tactical air support role.

(1) AirLand Battle doctrine requires the Air Force to possess the capability to control attacks against time sensitive ground targets.

(2) In order to optimize the ground attack control capability concept, all activities must be coordinated and synchronized with the total AirLand Battle.

(3) A preplanned product improvement (P3I) could be included in modular control equipment that incorporates a ground attack control capability.

(4) The tactical air control center (TACC) is currently involved in a systems automation upgrade program. The scope of this upgrade, designated as the contingency

tactical air control system automated planning system (CTAPS), could be expanded to include a ground attack control capability.

Limitations

Seven limitations constrain the bounds of this study.

(1) The study will address only a CONUS based tactical air control system with a worldwide mission requirement.

(2) The modular control equipment designed to replace the current TACS elements is still in the production phase. Fielding of the system is expected to begin in FY 91. Therefore, characteristics and capabilities are limited to contractor and specification data.

(3) The contingency tactical air control system (TACS) automated planning system (CTAPS), designed to automate tactical air control center functions is still in the development stage. Fielding of the system is expected in FY 91. Therefore, characteristics and capabilities are limited to specification data.

(4) The Tactical Air Command (TAC) has developed a statement of operational need (SON) for a ground attack control capability, and is a proponent of the concept. However, the concept has not received support from the other tactical air forces -- US Air Forces Europe (USAFE) and Pacific Air Forces (PACAF).

(5) The ground attack control capability examined in this study was originally identified as a preplanned product improvement in the AN/TYQ-23 modular control equipment (MCE) program awarded to Litton Data Systems.

However, software development for a modified MCE, that includes GACC, has been deferred and hardware modification of the basic MCE module to accommodate GACC is unfunded.

(6) The program to develop the joint surveillance target attack radar system (JSTARS), an airborne multi-mode radar and associated command, control, and communications equipment, is still in full scale development. Fielding of the system is expected to begin in 1994. Therefore, characteristics and capabilities are limited to contractor and specification data.

(7) A concept of operations for JSTARS has not been developed. In addition, procedures between the Army and Air Force for the exchange and coordination of mission-related JSTARS data has not been established.

Definition of Terms

The ground surveillance and control elements of the tactical air control system will be discussed later. The following definitions offer a brief explanation of the element's functions.

(1) Tactical Air Control Center (TACC). The TACC is the senior air operations element of the tactical air control system (TACS). It functions as the Air Component Commander's operation center/command post, providing the facility and personnel necessary to accomplish the planning, direction, and coordinating of tactical air operations.

(11:5-1)

(2) Control and Reporting Center (CRC). The CRC is directly subordinate to the TACC and is the primary radar element concerned with decentralized execution of air

defense and airspace control functions. (11:5-1; 9:3-12)

(3) Control and Reporting Post (CRP). The CRP is subordinate to the CRC. A CRP has capabilities similar to a CRC and may assume CRC functions when required. (9:3-12)

(4) Forward Air Control Post (FACP). The FACP is a mobile radar element that is subordinate to the CRC. It is normally deployed into forward areas to extend radar coverage and to provide control of air operations, early warning surveillance, and gap filler service. (11:5-1; 9:3-13)

(5) Modular Control Equipment (MCE). The MCE is a transportable, modularized system which is in production and expected to be fielded in FY 91. This new system will replace the message processing center, control and reporting center, and forward air control post. (14:1)

(6) Ground Attack Control Capability (GACC). The GACC is an emerging concept designed to more effectively and responsively provide decentralized execution of air attacks against time sensitive enemy ground targets designated by the TACC. (8:A-1)

CHAPTER II

THE CURRENT TACTICAL COMMAND AND CONTROL STRUCTURE

General

The tactical air command and control structure is established on the same principle which expresses how forces operate -- centralized control and decentralized execution. (9:3-2) This means that certain functions are centralized at the command level: taskings are coordinated, priorities are established and resources are allocated. However, the matching and directing of weapons to targets, and ensuring that forces move through the system in an efficient way are decentralized to the control level for execution.

The Cornerstone of TACAIR -- Command and Control (C2)

"An air commander's ability to conduct air warfare is enhanced by effective command and control of his assigned forces, reliable communications with those forces, and a timely and accurate intelligence system that can survey and assess battle actions and the combat environment in which man and machine will be used." (10:2-20)

Command and control within the tactical air control system (TACS) is accomplished by people working in accepted and proven military organizations, employing forces in tactical and operational environments -- using time proved methods. Four key elements are an integral part of the command, control, communications, and intelligence (C3I) process.

The first element in the C3I process is "command."

(9:3-2) The command part of the process is the function

which works to set priorities and strategies, and where forces are allocated. Allocation means assigning available weapons systems to specific jobs.

The second element is "control." The control side of the process involves people working to match weapons to targets according to the priorities and allocations given to them by a command level. (9:3-5) The people involved in this part of the process coordinate with joint forces to ensure decisions made during the command part of the process are translated into action during the control phase.

The third element, "communications" is an integral part of the command and control structure and process. Communications, when used in the context of this study, will refer to communications which are internal to the command and control structure and the interfaces that must occur with strategic communications systems.

The fourth element of the C3I process is "intelligence." (9:2-6) Intelligence is the element which provides direct support to tactical command and control functions and to weapons units. Intelligence, in the context of this study, also provides interfaces with external sources for information that may be of value to the structure and process.

There is one other element that deserves discussion as part of the C3I process -- the computer. Computers are an integral part of each element. They provide the data processing support which helps in the management of information for storing and retrieving, and also for displaying and transmitting information. However, the key

feature of computers discussed in this study is that they are highly interactive with the human user and aid in the command and control process.

The C2 Structure

The tactical air command and control structure, like any military combat organization, seeks to employ combat forces according to proven principles of war. (10:2-4) The ultimate goal in warfighting is to have: the right types of forces; in the right numbers; at the right place; and at the right time.

With effective command and control, the Air Force will be able to achieve this goal, and operate in the dynamic way our employment concepts demand. The following list illustrates what is achievable when an effective command and control structure is in place and operating effectively.

(1) The system will have the capability to present appropriate decision makers with understandable information.

(2) Accurate and timely situation reports will be available within the structure.

(3) Decision makers will be able to "see" the tactical situation as it develops.

(4) Decision makers and control levels will be able to posture forces correctly.

(5) Operators will be able to "see" targets accurately and be able to direct forces to the right target.

(6) Operators will be able to take advantage of the speed, maneuver, firepower and flexibility of aircraft.

(7) The system will possess the flexibility to rerole aircraft on the ground and retask aircraft in the air.

This list illustrates what is achievable when effective command and control is available. However, the other side of the equation is just as revealing. Without effective command and control, the ability to dynamically control forces can gradually degrade to the point where the only control provided is having forces operate according to preplanned instructions. In the worst case, this could mean having a single ship aircraft take off and be forced to "look for the fight/target". Should the aircraft be successful in engaging the enemy or finding the target there is still no way to determine if the target engaged/found is the correct fight.

With this background, highlighting the importance of command and control, let's now look at the individual elements in the command and control structure. This explanation will explain how each element contributes to the total command and control process.

Elements of the C2 Structure

Air Force Component Headquarters (AFCH)

Command and control structures worldwide have a single military focus. The mission of the structure is to ensure the employment process works effectively in a dynamic situation. Therefore, estimating and planning has to begin before the battle to ensure the system is prepared.

Estimating and planning is accomplished at the command level. (9:3-5)

To accomplish estimating and planning, command levels need appropriate information on both the enemy and friendly situation. This information has to be aggregated and

filtered so that it is usable by decision makers looking at an entire theater. The information used in the process can be obtained from sources as simple as human reports and as sophisticated as sensor reports. Intelligence information should be correlated from as many inputs as possible, including indirect sources. This process will provide baseline knowledge for the estimation and planning processes. (9:3-3)

The basic guidance that a theater air commander uses to develop his battle plan is derived from joint negotiations, and in the final sense comes from the theater or joint command level. (9:3-4) As the situation develops, the air commander and his staff take current information and build a plan which capitalizes on the capabilities of friendly forces. As the situation progresses to the point where it appears the plans are going to be executed, forces are moved to combat locations or at least placed on appropriate levels of alert, and the logistics structure for the theater is energized to support the planned concept of operations. As the situation further progresses, detailed instructions are given to the forces. This includes establishing standing orders to protect operations against the possibility that the command and control structure may be degraded during the battle. Finally, one of the key actions accomplished as the plan is developed is to prepare the control structure for combat. (9:3-4)

The air command level described above is the tactical air forces headquarters. It is at the tactical air forces headquarters that the command and staff structure is

established which provides guidance on overall objectives and priorities received from the theater (joint) command level.

Tactical Air Control Center (TACC)

Within the tactical air forces headquarters a battle facility is formed -- the tactical air control center (TACC). The TACC is the senior element of the TACS, and provides the focal point for command level coordination both upward and laterally. It functions as the commander's centralized planning, directing, controlling, and coordinating center for air operations. Within the TACC, C3I functions are performed for preplanned and immediate operations. These functions include: (1) determining the threat; (2) providing preplanned targeting and operational intelligence analysis; (3) disseminating essential elements of information; (4) receiving, integrating, and validating all requests for intelligence; (5) providing an imagery interpretation capability; (6) developing procedures for air support, strike/reconnaissance nominations; and (8) generating daily operations orders. (9:3-8) All of these functions can be organized into three distinct groups: combat plans (works activities one-two days out); combat operations (works "dynamic" combat operations); and intelligence (supports the combat plans and combat operations functions).

Execution Level Elements

Continuing on with the structure, the tactical air force headquarters decentralizes execution of the operation to the control level. There are three general control structures

identifiable in a tactical air command and control system: one for air defense and airspace management; another structure supports close air support and army support in general; and the third structure works the air interdiction and offensive counter air tasks. Let's now examine the role each structure plays in the command and control process.

Air Defense and Airspace Management Structure

The air defense and airspace management structure uses airborne and ground sensors to provide timely information on air targets. Information from the airborne sensors is passed by a data link to a ground processing station where it is filtered and processed for multiple users. Information from ground-based sensors come through voice and data link channels and is also filtered and processed for multiple users.

The principle user of air defense information is the control and reporting center (CRC). (9:3-12) The CRC, a control level activity, reports to the command level -- the TACC. The CRC provides threat warning to friendly aircraft; provides control or flight following information to both offensive and defensive missions; and relays mission changes to aircraft as directed from the TACC. Accomplishing this task requires the following: being able to "see" the air situation, and possessing a capability to communicate with friendly forces. When these two criteria are satisfied, the CRC will be able to provide control to accomplish its assigned task and mission.

Air defense control structures are tailored to the needs of a specific operational requirement. The configuration of

the structure depends on the mission to be performed, the geography, the threat, and sometimes, the capabilities of the system. To build a tailored system requires starting with several small surveillance and control sites called forward air control posts (FACP). These units report to larger radar sites which not only provide increased control capability but also increased surveillance coverage.

The airborne warning and control system (AWACS) can be added to the system to provide additional control capability. The AWACS provides a deep look surveillance capability to detect enemy air targets and provide detection of low altitude targets. The AWACS, and all other radar elements, report to the CRC -- the hub of the control structure. (9:3-13)

There is one last element of the air defense structure that deserves attention -- the Army air defense command post (AADCP). This Army air defense element is normally associated with the Army Corps. The primary mission of the AADCP is to control surface-to-air missile assets. By joint agreement, the CRC controls weapons assignment. Corps boundaries are established for ground maneuver reasons; however, they do not necessarily match the air defense boundaries which are established for air defense and airspace management.

Close Air Support Structure

The close air support (CAS) structure operates, principally, on visual reports through echelons of subordinate control elements. The close air support structure parallels Army organizational echelons at every

level from battalion up through corps. (9:4-41) Established air request nets for immediate and preplanned TACAIR are used to coordinate firepower. At the corps level, the Air Force control element is the air support operations center (ASOC). The ASOC controls assets allocated to the corps from the Air Force command level and they request additional assets when necessary.

Air Force control functions are all interrelated and the air defense and airspace management structure also helps to control close air support missions. For example, the air support operations center is responsible for planning, coordinating, and directing the immediate tactical air support for ground operations. Information is passed also to the control and reporting center which is responsible for the airspace. The control and reporting center directs the aircraft to the target and passes all necessary attack data to the aircraft enroute.

Control could also be passed to a subordinate control and reporting post and then to a subordinate forward air control post, and finally passed to an airborne or ground forward air controller for final conduct of the mission. The key here is, more than just the close air support structure works to ensure that the mission arrives at the correct place at the correct time. The entire Air Force command and control structure is working to accomplish the mission.

Air Interdiction/Battlefield Air Interdiction Structure

The control element used for air interdiction missions works a wide variety of static and time sensitive targets. Supporting intelligence information to locate and target

these threats come from a variety of sources. Mission report passed in flight and relayed through control elements airborne or on the ground provide most of the dynamic information. (9:4-31) Overhead reconnaissance provides planners with high quality information on which to base target planning.

Today, the Air Force does not have the capability to locate and attack air interdiction (AI) and battlefield air interdiction (BAI) targets in real time. By definition, air interdiction targets are usually second echelon targets located deep in enemy territory. These targets may also be mobile, and moving into position to pose a future threat to friendly forces. The targets are usually detected in near real time through the use of intelligence, imagery, or manned reconnaissance. Based on this data, a detailed plan is developed, an air tasking order is generated, and a strike aircraft flies the attack mission.

To accomplish this preplanned interdiction mission profile, procedural control is used more than it is for close air support and air defense missions. (9:4-33) Procedural control is defined as "a lesser degree of control provided during a battle and is used when participating individual elements have little or no external information provided to them to accomplish the assigned mission." (9:4-26)

There is actually a separate and decentralized function for controlling interdiction missions; however, the control function is typically embedded in a command level facility. That doesn't mean it is a command level function, it is just

physically located in a command level facility such as the tactical air control center discussed earlier.

It's important to emphasize that the air defense structure is available to assist interdiction aircraft and help ensure they arrive at the correct place at the correct time. Platforms such as the airborne battlefield command and control center (ABCCC) are often used to help extend communications range and provide additional control in dynamic situations. Thus, even though the air defense structure is available, variables like radar coverage, communications range/coverage, COMSEC procedures, and other tactical considerations may preclude the use of this capability.

There are a number of other missions which are controlled in much the same way as the interdiction tasks. For example, reconnaissance, electronic countermeasures, and enemy air defense suppression may be executed using procedural control. (9:5-1) These special or limited resource missions are also typically controlled by individuals embedded in command level facilities; however, they are technically decentralized functions. Very often, in a small scale operation, the same people who work interdiction efforts also work the special missions.

In summary, the command and control structure is established, it's an understood structure, and it is a working structure that is exercised on a daily basis. Again, it is important to emphasize that the interdiction function is a decentralized control function, but it is sometimes hard to recognize it because the physical location is

embedded within a command facility.

Other Tactical Air Command and Control Structures

To this point only one version of the tactical air command and control system has been discussed; however, there are actually three distinct versions. The Air Force participates in a substantial way in NATO's central region system which responds to a specific threat and mission. In addition, there is a Korean system which has a very specific focus and mission. The third system, the one used to describe the general structure and process, is actually a pool of people and equipment from which it is possible to extract specific elements to augment fixed systems or to establish a complete structure tailored to the needs of a specific contingency operation. This structure is called the "contingency TACS" and has the capability to respond to notional taskings. When trying to determine what is the best or right structure, it is best to be specific about the theater of operation and assigned mission.

When the three systems just described are mentioned, there is a tendency to conclude that they are not similar. However, on close examination, it becomes apparent that the functions performed are consistent. What is different is how the functions are packaged -- how they are put into buildings and facilities, and how they are organizationally structured.

For example, a U.S. Air Force tactical air control center is the functional equivalent of three different facilities in the NATO central region. This logic can be proven with the following illustration. A control and reporting center

function in the NATO central region is close to being the same as a U.S. Air Force CRC. However, the central region CRC reports to a sector operations center (SOC). The same is true for the allied tactical operations center (ATOC) which focuses on offensive operations. If you take the functions represented in the SOC and the ATOC, and combine them with the functions performed at the allied tactical air force (ATAF) headquarters, you have on a smaller scale, a U.S. Air Force tactical air control center. Similar comparisons can be drawn at the joint task force and allied air forces central region level.

This comparison is made to illustrate that facility-to-facility and center-to-center comparisons can be complicated, but functional comparisons are fairly straight forward. For example, just because the Boerfink Bunker (a NATO ATOC) in Germany contains functions for two command levels, various support activities and a twice removed control level activity, it doesn't mean facilities worldwide have to be packaged that way. Many practical factors drive packaging arrangements.

To sum up this discussion, the tactical command and control system is structured to employ air forces in an effective and flexible way. The functional structure is based on time proven principles of war. In addition, the system has evolved over time and the procedures used, both joint and service unique, are accepted and exercised on a daily basis.

Although the process works well, this does not suggest that improvements aren't needed. The diverse mission of the

tactical command and control system demands a highly capable and flexible system. This requirement dictates that the system possess the capability to counter the threat, execute service doctrine, and support national policy. However, equipment deficiencies in today's system are creating a technology and capability gap. This gap has resulted from not fielding command and control systems that keep pace with air power technology and the threat. This situation is starting to have an adverse impact on operational effectiveness, and raises an issue concerning the system's capability to support service doctrine and national policy. The next section will highlight these deficiencies and the operational impact.

System Deficiencies

The present tactical air control system equipment was conceived in the 1950's and 1960's and fielded in the 1960's and early 1970's. There has been no major modernization in the last twenty years, and the semi-automated equipment is fast reaching obsolescence. In addition, the equipment is becoming increasingly difficult to support. Although there has been no major modernization, there has been numerous efforts which addressed the need to modernize. The following is a chronological listing of the key efforts.

- (1) USAF ROC 8-75A (Improved Forward Air Control Post) -- 1976.
- (2) NATO Task Force Five Report -- 1977.
- (3) TAFIIS Master Plan Vol VI -- 1978/79.
- (4) NATO Rationalization, Standardization and Interoperability Master Plan -- 1978.

- (5) TACS Functional Management Inspection -- 1978.
- (6) TAC Zero Based Review of TACS -- 1978.
- (7) Dr Hermann Report -- 1979.
- (8) TAF CONOPS for Air Surveillance and Control Elements of the TACS -- 1979.
- (9) TACS C3 Mission Area Analysis -- 1980.
- (10) TAF SON 316-80 (Improved Surveillance and Control System) -- 1982.
- (11) Ground Attack Control Center (GACC) Statement of Need -- 1982.
- (12) TAF SON 302-88 (Air Support Operations Center Upgrade) -- 1989.

The deficiencies identified in these documents were translated and published in May 1979 in the Tactical Air Force Command, Control and Communications Mission Area Analysis Study. The deficiencies and their impact can best be described and scoped under three main headings: mobility, survivability, and operational capability.

Based on the TAF SON 316-80 a modernization initiative was started in 1983 to upgrade the air defense and airspace management elements -- the control and reporting center, control and reporting post, forward air control post, and message processing center. Today's equipment is being replaced with modular control equipment (MCE) and fielding is due to begin in FY 91.

This initiative, to modernize the air defense and airspace management structure, is a critical first step in the modernization process; however, the other two aspects of the TACS structure have not received the same level of

modernization emphasis. Specifically, that part of the structure that supports close air support and army support in general, and the structure that works air interdiction, battlefield air interdiction and offensive counter air tasks. These two areas suffer all the same deficiencies associated with the air defense structure, and only a very limited automation capability exists in these two areas. Today, the technology exist to modernize these TACS mission areas to keep pace with the rest of the tactical air control system and the threat. If a modernization initiative is not undertaken in these areas, the synergistic impact will eventually degrade the operational capability in the overall command and control structure.

One key deficient area centers on the problems associated with executing air interdiction (AI) and battlefield air interdiction (BAI) missions. For example, today the TACS command and control structure does not have the capability to provide decision makers with an accurate picture of the enemy ground situation. Specifically, the Air Force does not possess the capability to detect and display ground targets in real time and control and execute AI and BAI missions. This deficiency was documented in the 1982 statement of operational need for a ground attack control center. Finally, the current system is unable to handle real time intelligence data. The TACS is basically structured around a twenty-four hour planning cycle.

These problems will be illustrated in the next chapter which will examine the tactical command and control environment with particular emphasis on AirLand Battle. The

chapter will also discuss some new systems that are being designed and produced to operate on the AirLand battlefield. This discussion is intended to provide some insight into the systems that are forthcoming, and sets the stage for an evaluation of system architectures that will support the ground attack control capability concept.

CHAPTER III

THE AIR FORCE ROLE IN AIRLAND BATTLE

The Tactical Environment

It's axiomatic that tactical air command and control equates to employing air forces in a tactical environment; therefore, the nature of the environment is significant. (7:1-1) The tactical military environment has some very specific characteristics that deserve special consideration within the context of AirLand Battle operations.

First, the tactical environment can be described as a theater of operations with at least reasonable definite limits. (10:2-2) Examples of this include the Central Region, the Pacific, and the Southwest Asia theater of operation. The tactical environment is also characterized by a worldwide opportunity for having combat theaters. Tactical forces are designated to respond to contingencies on a worldwide basis, and when forces are employed, in most cases, the United States must deploy a tactical command and control system as part of the military weapons package. (9:3-5) As part of the military operation, the command and control system will be used to coordinate air, ground, and naval missions in a synchronized way to support theater objectives.

Within a specific theater of operation, the tactical environment has air forces performing a number of related air missions, in the same airspace, at the same time. (9:4-27) In addition, there may be a large number of sorties being flown by both friend and foe to accomplish the

diverse missions required of tactical air forces. Even the smallest tactical scenario can be characterized to some extent in the way just described. The numbers of sorties may be different; however, the diversity will remain constant.

Finally, ground force deployment has an important influence on tactical air operations, and therefore, an influence on the command and control structure. (9:4-39) With the importance placed on joint operations today, the battlefield should be viewed from an air-land perspective within the context of AirLand Battle doctrine. This focus will ensure coordination between and among services to exploit unique characteristics of each service and avoid duplication of effort.

The tactical environment is diverse and complex but an additional complexity adds to the challenge -- the environment is dynamic. The tactical situation will change on a minute by minute basis and tactical air power can be responsive to the situation if properly directed. Fortunately, the weapons systems used by tactical air forces today provide flexibility and responsiveness. The tactical command and control structure must be tailored to the tactical scenario, and it must exploit the potential provided by tactical air forces. This logic coincides with a point made earlier in this study. The fundamental military combat task of commanding and employing tactical air forces must be accomplished using proven principles of war. The job for tactical command and control is to ensure the right forces get to the right place, at the right time. This is where AirLand Battle doctrine, and Army and Air Force

missions that contribute to the employment of this doctrine, become important within the context of the tactical environment.

Air Force Contribution to AirLand Battle

The introduction of aircraft into modern warfare has necessitated a closer integration of air and land forces. This factor, coupled with advances in air power, has enabled military strategists to take a more realistic view of the battlefield. Today the Army's view of warfare has shifted from a linear, attrition-style battle to a more fluid battle fought in depth. The emphasis is on maneuver and is designed to capitalize on improved firepower and mobility.

(12:14)

This change in the way the battlefield is viewed has evolved into a new doctrine: AirLand Battle doctrine. (12:14) To understand the Air Force's contribution to AirLand Battle doctrine requires a study of roles and missions and how these roles and missions relate to Air Force service doctrine. Air Force basic doctrine does not specifically address air-land combat, but indirectly discusses Air Force missions which contribute to theater warfare and hence land operations. Specific operational doctrine is outlined in Tactical Air Command Manual 2-1, Tactical Air Operations. This operational doctrine looks at air-land battle from a theater perspective and emphasizes the speed, range, and versatility of air power. (9:1-1)

The Army's basic fighting doctrine also talks about the Air Force contribution to AirLand Battle. Army Field Manual 100-5, Operations, talks about three types of operations on

the battlefield: close, deep, and rear operations. (12:19) "Deep operations at any echelon comprise activities directed against enemy forces not in contact designated to influence the conditions in which future close operations will be conducted." (12:19) The manual goes on to say that "common to all operations -- close, deep, and rear -- is the necessity for superior command and control." (12:21)

Army Field Manual 100-5 also states that air interdiction and battlefield air interdiction are Tactical Air Force missions that contribute directly to the success of land operations. (12:48) One key aspect of land operations and AirLand Battle doctrine is the requirement to detect and attack second echelon targets deep in the enemy's rear area. If the Air Force does not possess a real time capability to detect and attack these targets, the overall AirLand Battle doctrine is placed in jeopardy.

This study concentrates on the challenge the Air Force faces trying to fight a fluid battle that extends deep into the enemy's rear area. The requirement to accomplish this task is embedded in the AirLand Battle concept and centers on the requirement to disrupt and delay the enemy's follow-on echelons from bringing their combat power to bear. To achieve this goal the Air Force must have a command and control structure that is tailored to the tactical environment and exploits the potential of TACAIR.

The Role of TACAIR in AirLand Battle

The Air Force has a vital role in AirLand Battle operations. Air Force Manual 1-1, Basic Aerospace Doctrine, outlines the missions and specialized tasks that

the Air Force is required to perform. One mission that relates directly to support to the ground commander is air interdiction. "Air interdiction (AI) objectives are to delay, disrupt, divert, or destroy an enemy's military potential before it can be brought to bear effectively against friendly forces. These combat operations are performed at such distances from friendly surface forces that detailed integration of specific actions with the fire and movement of friendly forces is normally not required." (10:3-3) The definition goes on to talk about the combat value of interdiction. "Interdiction of the enemy can delay the arrival or buildup of forces and supplies, disrupt the enemy's scheme of operations and control of forces, divert valuable enemy resources to other uses, and destroy forces and supplies." (10:3-3)

Battlefield air interdiction (BAI) is also discussed in AFM 1-1 and a distinction is made between AI and BAI. "Air interdiction attacks against targets which are in a position to have a near term effect on friendly land forces are referred to as battlefield air interdiction. The primary difference between battlefield air interdiction and the remainder of the air interdiction effort is the level of interest and emphasis the land commander places on the process of identifying, selecting, and attacking certain targets. Therefore, battlefield air interdiction requires joint coordination at the component level during planning, but once planned, battlefield air interdiction is controlled and executed by the air component commander as an integral part of a total air interdiction campaign." (10:3-4)

Today the air interdiction/battlefield air interdiction control structure conducts attacks against a wide variety of static and time sensitive ground targets. Information to support the targeting effort comes from intelligence sources, mission reports from aircrews, and reconnaissance missions. It takes time to collect this data, analyze the information, and then develop a viable target list. As a result, air interdiction and battlefield air interdiction control is done, principally, by executing preplanned air missions. (9:4-31) The Air Force does not possess the capability to locate rear area targets in real time and make dynamic adjustments in response to a changing ground threat. This inability to respond to immediate ground threats in the enemy's rear area requires the Air Force and Army to plan attacks against ground targets using information that may be as much as forty-eight to seventy-two hours old. (9:4-31)

Air Force Electronic Contribution to AirLand Battle

The inability to detect and control attacks in real time against time sensitive ground targets is a limiting factor in the Air Force's ability to execute air interdiction and battlefield air interdiction missions. However, several systems are being developed that will help eliminate this shortcoming. The following is an explanation of each system, and the capability it has to detect and attack ground targets.

Joint Surveillance and Target Attack Radar System (JSTARS)

One key to attacking time sensitive air targets effectively is the capability to "see" the target. This is accomplished today in the air defense environment using the

air situation display provided by radar. For attacking time sensitive ground targets, joint surveillance and target attack radar system (JSTARS), and its inherent data link capability, will give the Army and Air Force timely data on ground situation displays needed to fully apply the principles used today in the air defense system. (7:32)

The Army and Air Force realize that in order for AirLand Battle to be a viable doctrine, the services must have the capability to detect ground targets deep behind enemy lines. In addition, they must have systems that can disrupt and destroy these second echelon forces. JSTARS provides the capability to detect these targets, and is a joint Army/Air Force program to field a radar and attack control system that supports the AirLand Battle strategy. (3:59)

"JSTARS provides an airborne radar for detecting, tracking, and classifying enemy ground forces, along with processing equipment, controller stations, and command and control interfaces. It can provide targeting information to tactical aircraft, standoff missiles, or Army artillery for precise, real-time attacks against moving enemy targets, including helicopters and slow-moving, fixed-wing aircraft." (2:41)

The JSTARS program is currently in full scale development and operational test and evaluation should begin in FY 91. If all activities and funding support remains constant the program should lead to a limited operational capability in FY 95. (2:43)

Grumman Corp., United Technologies' Norden Systems Division, and Boeing Military Airplane Company are teamed to

develop the JSTARS airborne segment, consisting of the phased-array radar, signal-and-data processing equipment, and operations and control subsystems aboard the E-8A aircraft." (4:79)

Contingency Tactical Air Control System(TACS) Automated Planning System (CTAPS)

The initiative to modernize the tactical air control center (TACC) has been an evolutionary process. In September 1986 the Air Force Systems Command (AFSC) Commander sponsored a briefing to the HQ TAC Commander on decision aids for tactical battle management. The following recommendations were proposed as a result of this meeting. (13:--)

1. Take aggressive action to bridge the excessive time gap between development and fielding of operational systems.
2. Implement evolutionary acquisition of selected command and control initiatives.
3. Establish a user/developer testbed to emphasize user involvement.
4. Make maximum use of off-the-shelf hardware and software.

This study spawned the development of Tactical Battle Management (TBM), a program to enhance battle management decision aids at the command level. A strategy was also developed for phasing of responsibility for certain command and control acquisitions between the Tactical Air Command (TAC) and Air Force Systems Command (AFSC). Among other agreements, TAC would continue work on a Sacramento Air Logistics Center (SM-ALC) managed tactical air control

center decision aid modification project and AFSC would expedite design of a modernized air support operations center (ASOC) van. (13:--)

During this same period, the modification initiative experienced problems with ill-defined user requirements and specifications. At this point HQ TAC revitalized efforts to modernize the TACC and also extended efforts to provide commonality with the on-going ASOC program. Out of this initiative came the CTAPS concept for TACC and ASOC modernization. (13:--)

HQ TAC selected the Idaho National Engineering Laboratory (INEL), Department of Energy to do the work on the CTAPS project. SM-ALC was included as a prime player for follow-on production contracting after rapid prototyping and establishment of system life cycle support. (13:--)

Hardware prototyping is on schedule and six prototype TACC shelters are being constructed. Software for the program is being developed by a number of agencies, but the integration is being managed by INEL. User evaluations of the software are ongoing and a preliminary decision aid package is at INEL undergoing evaluation and design review prior to integration. Exact details are still being worked; however, the software package will automate all TACC functions to include the integration of intelligence and operational reports which are required to develop an air tasking order (ATO). (13:--)

The CTAPS program will also have the growth capability to receive and process JSTARS data and display data on workstations in the TACC. The potential exists to have this data evaluated and become part

of the data base upon which air tasking decisions could be based.

Enemy Situation Correlation Element (ENSCE)

Detecting ground targets with radar is only one aspect of how a real time ground situation display is developed. Intelligence plays an important part in the process and the joint tactical fusion program was established by the Air Force to develop an automated targeting, collection management, situation analysis, and intelligence production capability for overall battle management. Specifically, this capability will be used to enhance air tasking order (ATO) development and execution. The air tasking order will include but not be limited to the following information: the type mission to be flown, the number of sorties in each mission category, and the unit that will fly and control the sorties. The Air Force program designed to provide this capability is the Enemy Situation Correlation Element (ENSCE). (13:--)

The ENSCE, along with its Army equivalent, the all source analysis system (ASAS), will provide a common picture to Air Force and Army tactical commanders. (3:60)

As part of the tactical air control system (TACS) modernization effort, ENSCE will provide the intelligence compliment to the contingency TACS automated planning system (CTAPS). ENSCE will be used to provide ground situation information to both intelligence and operations functions within the tactical air control center (TACC). The system was originally called the automated tactical fusion division but the name was changed when some system changes

and enhancements were incorporated several years ago.

The ENSCE provides straightforward automated assists, and the system has the capability to accept, store, sort, and display information. This information will come from several sources which will make the process somewhat complex; however, the information will be correlated to provide a dynamic situation display tailored to the user. A tremendous amount of display flexibility is embedded in the system and terminals can be remoted to multiple users.

This capability will give operators and decision makers in the TACC the displays and associated information to work inside the air tasking order cycle and dynamically update ground attack mission data based on intelligence reports. Operators will have to work very closely with intelligence personnel who will interpret the data and use the information to analyze the situation and develop estimates.

The current program status for ENSCE is not clear. The ENSCE software is scheduled for release in late FY 91 or early FY 92. In FY 88, funding cuts resulted in loss of procurement dollars necessary to purchase ENSCE hardware. Currently HQ Tactical Air Command (HQ TAC) is investigating the feasibility of hosting ENSCE on hardware being procured under CTAPS. The rationale for this strategy is twofold: achieve needed operational and intelligence integration at the TACC and field a capability near term by combining two complimentary programs. (13:--)

The ENSCE capability will play a key part in the Air Force's ability to execute TACAIR missions in support of AirLand Battle doctrine. ENSCE, along with the Army's ASAS,

will for the first time, provide tactical air and ground commanders virtually identical pictures of the battlefield, and will greatly enhance battlefield interoperability. In addition, the operational integration potential will provide the Air Force an automated intelligence capability for the air component commander.

Joint Tactical Communication Program (TRI-TAC)

The TRI-TAC program is a Department of Defense directed effort to develop and acquire joint service communications equipment. TRI-TAC is designed to fulfill a multi-service tactical communications requirement. It will provide connectivity for other emerging tactical command and control systems.

The major objectives of the TRI-TAC program are as follows:

1. Establish a higher degree of interservice interoperability with identical or similar communications gear.

2. Use state-of-the-art digital equipment.

3. Provide end-to-end securable communications.

The TRI-TAC program is currently replacing aging long-haul tactical transmission equipment, technical control facilities, circuit and message switches, and subscriber terminals (telephone, teletype, telefax, etc). TRI-TAC equipment items are currently being tested and fielded.

In summary, this chapter examined the Air Force's contribution to AirLand Battle doctrine and the role TACAIR plays in offensive operations. The examination included a look at the systems currently being procured that will

enhance AirLand Battle operations. With this foundation, let's now look at other initiatives that could help make AirLand Battle a more viable and executable doctrine.

CHAPTER IV
THE OPTIMUM COMMAND AND CONTROL STRUCTURE
TO EXECUTE AIRLAND DOCTRINE

General

The purpose of this chapter is to examine the initiatives that are being undertaken to modernize the tactical air control system (TACS). The first initiative that will be examined is the modular control system (MCE) program. The MCE program is designed to correct longstanding deficiencies in the air defense and airspace management structure; however, the program offers some growth potential for correcting problems in other areas of the TACS. In this examination we will discuss modular control equipment characteristics and capabilities and preplanned product improvements (P3I) that might help solve problems in other areas. The study will then focus on a second TACS deficient area -- the ground attack control capability (GACC). This portion of the chapter includes a review of the statement of operational need (SON) for a GACC, and a description of three system architectures that will meet the requirements outlined in the SON. The last portion of the chapter is devoted to describing three approaches the Air Force could take to implement a GACC.

Historical Review of TACS Modernization

In October 1979, the Tactical Air Forces (TAF) agreed to a basic preferred solution to TACS modernization. This preferred solution involved a building block approach to support U.S. contingency requirements. It was agreed that

the system should have the technology to be interoperable with evolving command and control systems within NATO and Korea and meet the postulated threat through the mid-1990's. The preferred solution for modernization involved the development of a series of standardized vans, each designed to meet specific functions.

The conceptual design called for four vans to provide the desired capability. A radar/communications van would be a modified AN/TPS-43E radar van with a radar processor added. This would provide a minimally attended radar capability and permit the automatic transfer of radar plots to an adjacent or rear control facility. The second van would include a standard processor, operator display consoles, TADIL A, and a bussed communications interface. This van would provide limited control and exchange of track information with the USAF E-3 AWACS and other service systems. Vans one and two would equate to a mini-FACP. The third van would provide more operator consoles to expand the FACP capability up to and including a full CRC capability. Finally, a fourth van would provide the capability for fully automated interface management, area/regional air defense, and airspace control. Based on the operational requirement, these basic vans could be brought together in various combinations to satisfy the command and control support desired.

Two approaches were considered by the TAF to attain the desired capability. One was to develop a statement of operational need (SON) that would be all encompassing and would address modernization in terms of the total system. The second approach was to use an already validated

requirement for a forward air control post replacement system (ROC 8-75A) as the basis for the modernization effort and follow it up with additional SON's to complete the process. The ROC 8-75A approach was chosen because it could be used to quickly initiate the modernization process. This ROC, plus the development of TAF SON 316-80, for an improved surveillance and control system, formed the basis to modernize the facilities. However, ROC 8-75A was not funded for FY 81. This was viewed as a major setback to modernization. To overcome this delay, the Air Staff directed a review of viable alternatives to the agreed TAF-preferred solution, specifically the Litton TAOC-85 being developed for the U.S. Marine Corps.

USAF Candidate -- Modular Control Equipment (MCE)

In late 1979, the USAF requested formal monitoring of the U.S. Marine Corps program. In July 1980, the Air Force completed a study to determine if TAOC-85 was the best approach to satisfy USAF requirements. The results of this study were favorable and in May 1981, TAOC-85 was selected as the USAF candidate. Litton Industries was then tasked to define necessary system design changes for a USAF modular control equipment capability. The U.S. Marine Corps contract was modified in July 1982 to include a USAF MCE effort. (16:59)

The MCE provided commonality of equipment for the ground TACS, and the objective was to modernize the operational facilities of the control and reporting center (CRC), control and reporting post (CRP), message processing center (MPC), and forward air control post (FACP).

Tailoring the MCE to a particular requirement is achieved through the use of one or more tactical air operations modules (TAOMs). Depending on the tactical situation, any combination of one to five operational modules may be interconnected. Each operations module includes a functional control and reporting center and message processing center capability. A single operations module provides distributed data processing, operator displays, organic UHF, VHF, and HF radios for ground/air voice, TADIL A, TADIL B, LINK-1 (Allied command and control connectivity), and teletype. External connectivity includes: ground/air radios, AN/TRC-97 interconnects, TRI-TAC switch interconnectivity, and radar interfaces. (15:28)

The USAF is currently scheduled to receive 139 operational modules. (13:--) Production is ongoing and the tactical air operations modules are scheduled to begin arriving at operational units in FY91.

Ground Attack Control Concept

The evolutionary nature of TACS modernization, and the decision to pursue a joint development project with the U.S. Marine Corps, was a key step toward correcting the air defense deficiencies associated with the current TACS. However, in choosing this course of action the other deficient area, the ground attack control area, was not addressed.

As already discussed, the Air Force is required to support the Army by providing close air support (CAS), air interdiction (AI), and battlefield air interdiction (BAI) support to the ground commander. However, no modernization

initiatives were being undertaken to enhance operational capabilities in these areas. To correct these limitations, the TAF developed a statement of operational need (SON) for a ground attack control center (GACC) capability. The SON was drafted and approved in 1982; however, it never received wide TAF support and consequently only limited specification and design work was accomplished.

In April 1986 the Joint Studies Group at Langley AFB, Virginia published a study entitled: Joint Operational Interface of the Ground Attack Control Capability Study. This study changed the 1982 approach and described the concept in terms of a "capability" rather than a "center". It also explained how the GACC could be envisioned to fit into the twenty-first century TACS.

Once the TACC has received the LCC (land component commander) air interdiction (AI) nominations and the prioritized battlefield air interdiction (BAI) target list from the BCE (battlefield coordination element), the TACC plans the BAI sorties and support packages to meet the LCC request. Additionally, it matches air assets against the target list to provide the forces required to achieve the effect on each target. If BAI requirements exceed assets, the TACC coordinates with the BCE to restructure objectives. After final coordination of BAI targets between the TACC and BCE, the ATO (air tasking order) is published by the TACC. The GACC can function in several roles. Using near-real-time data from sensors and automated intelligence functions, it can exploit its unique capability to execute attacks inside the ATO (air tasking order) process. Additionally, it can help the TACC execute the published ATO. It is envisioned that the GACC will devote most of its time to executing missions in the ATO. However, execution of attacks against time-sensitive targets will receive priority. Using the target, priorities and sorties assigned in the ATO, the GACC can help orchestrate TACC

approved attacks. It transmits mission information to flying units, coordinates ingress and egress routes and target location with control elements of the TACS and keeps aircrews updated on target location, description and threat environment. Through the transmittal of real-time information, the GACC enhances the aircrew's ability to successfully attack the designated target. Additionally, GACC can receive in-flight reports from attack aircrews and pass them to the TACC for post-attack analysis. While executing the ATO, the GACC, utilizing sensor and intelligence inputs, may detect non-preplanned targets which meet the rules of engagement (ROE) specified in the ATO. In these instances, the GACC will recommend a target/weapon match to the TACC for execution approval. In this sense, the GACC plans these missions and matches assigned sorties with possible targets. However, in all cases, the TACC has final approval authority. (8:1-2)

This description of GACC differs somewhat from the requirement stated in the 1982 SON. The most significant difference involves the actual "control" of aircraft to the target. The original SON described the need for an operations control function and capability dedicated to controlling attacks against time sensitive ground targets. This concept was based on the theater air defense control structure of the tactical air control system. Specifically, the original concept called for the decentralized execution of air attacks against designated time sensitive ground targets to a ground attack control function modeled on the control and reporting center.

The 1986 concept revised and refined the GACC role. The GACC would fill a void by assisting in attacking time sensitive ground threats. Like the control and reporting center, the GACC would be a decentralized level

agency and receive its guidance and tasking from the command level structure through the tactical air control center. The GACC would utilize sensor data from JSFARS and integrate this with intelligence data to refine target data after the air tasking order had been published. The GACC would also assist planners by providing a capability to identify and prioritize second echelon ground targets.

This new sensor data would provide the needed accurate and timely information on ground targets. The GACC would make it possible to respond quickly and attack enemy targets located, for the most part, in the enemy rear area. The GACC would integrate real time sensor information with other elements of the command and control structure. This totally integrated air/ground network would locate targets, match weapons to targets according to guidance and priorities, scramble or divert allocated aircraft, and work inside the air tasking order to refine and update target information prior to launch and in some cases enroute to the target.

This conceptual difference between the original SON and the 1986 study on how the GACC could be employed illustrates the difference in what type of capability is needed to execute the ground attack mission. The next section examines three system architectures that will provide a ground attack control capability. The three approaches cover a full range of capabilities from a "control" type system to a more passive "air tasking order facilitator" capability.

Candidate System Architectures

Modular Control Equipment Preplanned Product Improvement

An opportunity to develop a ground attack control capability resulted from the similarity between the GACC process and the control and reporting center (CRC) process. This similarity makes it possible to integrate or collocate a GACC function with a TACC/CRC function. When the U.S. Marine Corps contract with Litton Industries was modified in 1982 to include an U.S. Air Force modular control equipment effort, GACC research and development was included in the project effort. Litton determined that a GACC capability could be developed using modular control equipment as the hardware baseline. (15:101)

The overall concept was straightforward; however, software changes provided the primary challenge. The Litton approach was to make changes to the existing modular control equipment software to allow the AN/TYQ-23 to perform either the CRC/FACP or GACC mission. The system was intended to have a capability to display the air and ground situation, monitor the execution of the air tasking order, and provide automation for the efficient execution of interdiction missions.

This concept centered on receiving ground target data from the JSTARS aircraft. Processing of raw radar data would be done in the aircraft and the command and control information would be transmitted down to a tactical air operations module (TAOM) via a joint tactical information distribution system (JTIDS) link using a Class 2 JTIDS terminal.

Litton Industries did preliminary work to determine the magnitude of this effort. However, in FY 89 HQ TAC

deferred funding for GACC software development. In addition, TAC lost all funding support for GACC hardware design. Today Litton Industries is receiving no Air Force funds for GACC hardware or software development. (13:--)
Litton did provide a rough cost estimate for a GACC operations module during the preliminary study. Cost estimates at that point were approximately \$6.0 - \$6.5 million per tactical air operations module. (13:--)

Contingency Tactical Air Control System Automated Planning System (CTAPS)

The second approach to fielding a ground attack control capability is through the contingency tactical air control system (TACS) automated planning system (CTAPS). As discussed in Chapter 3, the CTAPS initiative is designed to modernize the tactical air control center (TACC) and later the air support operations center (ASOC). The CTAPS program has strong support from HQ TAC, and hardware prototyping and software design is currently ongoing. (13:--)
The enemy situation correlation element (ENSCE) initiative is a key part of the CTAPS program. Including a ground attack control capability and ENSCE as part of the TACC automation effort would enable the Air Force to integrate intelligence and operations information, and automate all TACC combat operations and combat plans functions.

The CTAPS program provides the capability to field a ground attack control capability as part of the TACC automation. (13:--)
The concept involves using the JSTARS platform as an airborne operations and control unit. The display of real time enemy ground targets would be

centralized on consoles located onboard the JSTARS E-8A aircraft. Real time control of friendly fighter aircraft would primarily be accomplished using raw radar data processed and displayed inside the aircraft. An air situation display data base would be displayed onboard the aircraft and command and control display information would also be transmitted to workstations in the TACC. (4:80)

The information received by the workstations would be correlated with intelligence information received through ENSCE. The fused target intelligence provided by ENSCE along with target information from the E-8A would provide the TACC with the information to make target selections and plan attack missions. Final approval authority for attack execution would remain with the TACC. Using this concept, the TACC would be the focal point for gathering information to plan air interdiction and battlefield air interdiction attacks. Limited real time control against ground targets could be accomplished from operations consoles onboard the E-8A or in the CTAPS; however, authority to attack targets would reside at the TACC and not be decentralized.

U.S. Army System Architecture

The Army requirement for ground target information differs from the Air Force in some respects. The Army has a requirement for four command, control, communications, and intelligence (C3I) nodes in each division, and the number of Army divisions within a corps will vary depending on the tactical situation. (4:80) To accommodate this requirement the JSTARS data base will be distributed among two-operator ground station modules (GSMs) with a GSM assigned to each

Army C3I node. Each of the GSMs will receive raw radar data from the aircraft over the surveillance and control data link, and will process the data for dissemination to the C3I nodes. (4:80)

Motorola won the U.S. Army contract and is the sole source contractor responsible for developing the ground station modules that will receive, process, and disseminate the radar data transmitted from JSTARS. The nomenclature for the ground station module is the AN/TSQ-132. This GSM is comprised of a two-operator, S-280 shelter and can be carried on a 5-ton truck. In addition, Motorola has received a second contract to develop a downsized version of the GSM that can be installed on two highly mobile multipurpose wheeled vehicles for improved transportability. (4:80)

In addition to the GSM development effort three other contractors are involved in projects to totally integrate the JSTARS data with the ground stations. Cubic Defense Systems has a contract for development of a surveillance and control data link (SCDL) that will carry the radar data from the aircraft to the ground stations. Aydin Corp has received JSTARS contract money to provide a militarized display signal generator for the airborne and ground segments. Control Data Corp. has a contract for the JSTARS programmable processor, and Rolm Mil-Spec Computer Co. has been awarded a contract to develop a general purpose color monitor for the ground stations. (4:79)

Three Approaches to Implementing a GACC

Based on the system architectures described in the

previous section, there are at least three options available to the Air Force for fielding a ground attack control capability. The following are the three options, and what would be involved in achieving the capability.

(1) Modular Control Equipment (MCE) Preplanned Product Improvement: One approach would be to use modular control equipment as the architecture baseline upon which to develop a disciplined preplanned product improvement process. The modular control equipment program originally began as a replacement for the aging equipment the Air Force is using in the theater air defense/airspace management structure. Modular control equipment will replace equipment currently used at the forward air control posts, control and reporting centers and posts, and the message processing center. The message processing center provides the E-3 downlink in addition to providing some other command and control airspace management capabilities.

Modular control equipment stands alone except for sensors, power and point-to-point communications. Each tactical air operations module can accept processed sensor inputs directly from ground radar sets or via data link from more remote sources such as the E-3. In addition, these modules provide great flexibility in that they can be used singularly, or in combination to establish control functions of various sizes. At the same time some survivability benefit is achieved since these modules can be physically separated.

The tactical air operations modules could be modified using a P3I approach to provide a capability to display

processed data on ground targets just as well as on air targets. This would give the Air Force an opportunity for a ground attack control capability. For example, the MCE accepts existing M-series data messages which describe a variety of ground target types. (16:40) This is important because the jointly approved interface standard is the M-series message. The modular control equipment accepts both types of tactical data links -- TADIL A and TADIL B. In addition, a JTIDS capability will be fielded with modular control equipment, and JSTARS could be integrated using a JTIDS link. (2:41) These data links will provide communications flexibility and connectivity with the current sensor platforms and systems and growth potential for the future. Finally, the modular control equipment symbology set also supports appropriate ground target displays. Given these similarities, it is possible to develop a ground attack control capability using the modular control equipment hardware baseline with a modified software package that supports a ground attack mission.

Total requirement: The CONUS based tactical air control system today is comprised of three control and reporting centers, six forward air control posts and two tactical air control centers. The original concept proposed by HQ TAC was to colocate or operationally associate a ground attack control capability with each control and reporting center and forward air control post. However, when the concept was revised in 1986 it called for placing three tactical air operations modules with each TACC. Using this approach, six operator positions would be available at each TACC to

perform the GACC function. This concept would require a total of six tactical air operations modules (3 TAOMs x 2 TACCs) to field a CONUS based ground attack control capability.

Total cost: Cost estimates for a ground attack control capability modeled on the MCE are extremely soft because hardware and software development has been deferred. However, for the purpose of this study, \$6 million per module is reasonable for planning. Production cost would total \$36 million (6 modules x \$6 million each) plus \$6 million for research and development. Total cost would be approximately \$42 million. (13:--)

(2) Contingency Tactical Air Control System Planning System (CTAPS): A second approach would be to use CTAPS as the architecture baseline upon which to field a ground attack control capability. The current tactical air control center has some serious shortfalls which are being addressed with CTAPS. The primary deficiency is the lack of computer-to-computer electronic connectivity between each echelon in the tactical air control system and fighter air bases. With today's system each element has to manually (voice) report all tactical information. CTAPS will use tactical communications (TRI-TAC) to electronically interface computers at the following locations: tactical air control center, air support operations center, wing operations center, and flying squadrons.

The contingency TACS automated planning system concept uses a data base management system called ORACLE-STAR, and an operator system based on industry standards. (13:--) The

design will employ workstations at operator positions, and the system will be user friendly. As part of this interactive program the enemy situation correlation element (ENSCE) could be added to provide intelligence and target nomination updates.

A ground attack control capability could be integrated into the CTAPS program by designing a capability to receive near real time information from the JSTARS airborne platform. This information would be integrated with other CTAPS data, including ENSCE intelligence data, to build a data base for planning attacks against air interdiction and battlefield air interdiction targets.

Total requirement: Currently there are two tactical air control centers in the CONUS tactical air control system. The HQ TAC concept calls for replacing each TACC operations center (AN/TYQ-92) with twelve modular vans. Workstations to display near real time JSTARS data could be located in the combat operations division, the combat plans division, the battlefield coordination element and the intelligence cell.

Total cost. Initial CTAPS prototype design and software integration effort indicates it will cost approximately \$7.2 million to develop and produce a GACC within the CTAPS architecture. (13:--) This price tag includes fielding a capability at each CONUS TACC.

(3) U.S. Army Motorola System: A third approach calls for pursuing a joint initiative with the Army that takes advantage of the work that has been ongoing with the Motorola Ground Station Module (GSM) initiative. Each of

the Army GSMS receive raw data from the JSTARS aircraft over a surveillance and control data link being developed for the Army. The Air Force could assess the feasibility of jointly developing a capability that satisfies Air Force requirements. This joint initiative could be modeled after the U.S. Air Force and Marine Corps AN/TYQ 23 modular control equipment program.

In pursuing this course of action the Air Force could develop a capability to see ground targets in real time and control attacks against these targets. The concept and capability would be similar to the capability described earlier for the preplanned product improvement for the MPC.

Total requirement: The concept of employment would be much the same as with the modular control equipment based ground attack control capability. Using this concept a total of six GSMS would be required -- three GSMS at each TACC.

Total Cost: The cost of this initiative is unknown. The Army is under contract for \$75 million for the full-size GSM and about \$40 million for a downsized station. In addition, \$25.3 million has been earmarked for a surveillance and control data link, \$31 million for a militarized display signal processor, \$31 million for a JSTARS programmable processor, and \$12 million for color monitors at the ground stations. (4:79) Cost estimates would have to be conducted to determine costs for a joint effort.

In this chapter we examined the initiatives that are being undertaken to modernize the air defense and airspace

management structure. We then looked at postulated ground attack control requirements, and candidate Army and Air Force system architectures that would support the ground attack mission. Finally, three approaches to implementing an Air Force ground attack control capability were discussed. It's now time to determine the operational value of a ground attack control capability and evaluate three options.

CHAPTER V

THE CURRENT TACTICAL AIR CONTROL SYSTEM VERSUS
A GACC-BASED SYSTEM FOR AIRLAND BATTLE

General

This study has addressed the role of the Air Force in AirLand Battle, and how the Air Force tactical command and control structure contributes to the execution of AirLand Battle doctrine. The examination has looked at the elements of the command and control structure and the system deficiencies. One deficiency was the inability to detect ground targets and control missions against second echelon targets deep in the enemy's rear area. Based on this lack of capability to totally support the ground commander, a command and control structure, that included a ground attack control capability, was discussed. With this baseline, three system architectures were examined that could provide an Air Force ground attack control capability.

It is now time to evaluate the effectiveness of today's tactical air control system in executing AirLand Battle doctrine. Next the ground attack control capability contribution to AirLand Battle will be analysed. Finally, based on this comparison, it will be possible to determine if a ground attack control capability will significantly enhance the tactical air control system's capability to conduct effective command and control of TACAIR in support of AirLand Battle doctrine. The study will then evaluate three options available to achieve a ground attack control capability and recommend the one that provides the most

significant enhancement to the system. Three evaluation criteria will be used: (1) effectiveness of tactical command and control structure; (2) capability to support AirLand Battle doctrine; and (3) cost to implement the capability.

Today's Tactical Command and Control Structure

Effectiveness of the Structure

To be effective, an air command and control structure must be capable of employing the right type of forces; in the right numbers; at the right place; and at the right time. This section addresses only one aspect of the requirement: providing effective tactical air support to the ground commander. The discussion centers on being able to execute air interdiction (AI) and battlefield air interdiction (BAI) missions against time sensitive targets deep in the enemy's rear area.

The current system has a serious deficiency in executing the AI and BAI mission. To illustrate this point, let's first view the process from the control level, and then step up and examine the process at the command level. At the control level, the operator is not able to "see" the ground tactical situation as it develops. Without this capability the operator is not able to generate accurate and timely situation reports on how the battle is developing. In addition, if the threat is not clearly presented, the operator will not be able to take advantage of the speed, maneuver, firepower and flexibility of the available air assets. Finally, it will be difficult to rerole aircraft on the ground and retask aircraft in the air without a clear

understanding of the threat. This overall lack of situation awareness equates to a loss of flexibility.

The problems experienced at the control level are amplified at the command level. Today air interdiction and battlefield air interdiction missions are planned in advance based on intelligence information that is sometimes twenty-four to thirty-six hours old. The procedures for executing these missions are primarily procedural in nature and involve responding to guidance in the air tasking order. Aircrews use the air tasking order to conduct mission planning, then fly to the preplanned target and conduct the attack. There is no way to determine if the the enemy ground target has moved; therefore, decision makers lack the capability to respond to changing target information and requirements in real time. Decision makers also lack the capability to respond to the dynamic tactical environment. Specifically, they lack the capability to posture forces in response to the tactical situation -- have them at the right place, at the right time.

This review illustrates that there are some serious deficiencies with today's air interdiction and battlefield air interdiction process. The question then is -- will a ground attack control capability correct these problems? The answer is yes. The problems can be corrected if the following conditions exist: the operator has the capability to see enemy ground targets in real time, and if timely information is available to decision makers. If ground targets are detected and the information is forwarded to the command level, aircraft can be rerolled or retasked

based on the most accurate and recent target data

In summary, the air defense and airspace management structure is well defined and established. A ground attack capability would compliment this system and enhance planning at the command level. In addition, a ground attack control capability would enhance the execution process. Let's now look at what application a ground attack control capability may have for executing AirLand Battle doctrine.

Capability to Support AirLand Battle Doctrine

Today's tactical AirLand Battle environment is diverse and dynamic. The weapons systems being employed are flexible and responsive; however, the tactical command and control structure that directs the operation has not kept pace with the tactical environment or the capabilities of the aircraft employed in the environment. The maximum force multiplier capability cannot be achieved without a command and control structure that is as capable as the weapons systems being employed.

To successfully execute air interdiction and battlefield air interdiction missions every aspect of the command and control process must be integrated. First, the air and ground component commanders must have information on where the threats are located. Based on this a priority can be assigned to each threat. Next comes the allocation and apportionment process. Today there are gaps in this process. Information on where the threats are located is received from intelligence sources, mission reports from aircrews, and reconnaissance missions. This information is valuable, but it isn't always timely. This delay in

receiving current threat data has a corresponding negative impact on the rest of the process.

The ground attack control capability will add one more dimension to this collection gathering process by being able to detect static and moving targets deep in the enemy rear area. This additional capability will enhance today's procedural process and has the potential to add a new dimension -- near real time position reports on second echelon ground forces.

In summary, the current tactical command and control structure does not possess the capability to adequately support AirLand Battle doctrine. There are weaknesses in the process and system that need to be addressed. Specifically, decision makers are limited in their ability to make appropriate force posturing decisions. This results from a lack of timely ground threat information. A ground attack control capability will enhance the Air Force contribution to AirLand battle at two levels. At the command level, target information will be available, and can be used to improve the prioritization and planning process. At the execution level, the Air Force will be able to respond in near real time to the changing enemy ground order of battle and threat. This is made possible by the capability to "see" the threat as it changes on the fluid battlefield. This flexibility will enable the Air Force to better execute AI and BAI missions in support of the AirLand Battle doctrine.

A Ground Attack Control Capability (GACC) Based Tactical Air Control System

Having established that a ground attack control capability will enhance command and control of TACAIR operations let's now determine which approach will best satisfy this requirement. Three options have been proposed and will be discussed in this section: A modular control equipment (MCE) preplanned product improvement (P3I), the contingency tactical air control system automated planning system (CTAPS), and a joint Army and Air Force development initiative based on the Motorola ground station module (GSM).

Modular Control Equipment Preplanned Product Improvement

The Air Force is jointly developing a replacement system for the outdated 407L equipment currently used in the air defense environment. This system architecture does have the capability to facilitate evolutionary development toward a fully capable command, control, communications, and intelligence (C3I) system. This could be achieved through a P3I initiative to the modular control equipment program. The following discussion will examine the potential effectiveness and capability of such a program.

1. P3I: Effectiveness of the System

The modular control equipment architecture advocates a physically dispersed and functionally distributed system that provides maximum survivability and sustainability for foreseeable threat environments. The TRI-TAC communications equipment will provide the communications connectivity to interface with other service and allied systems. In addition, a standardized message format for the exchange of data ensures interoperability for joint and combined

operations.

Although the current modular control equipment effort is focused on air defense, Litton Data Systems has indicated that the modular control equipment hardware and software can be tailored to accommodate a ground attack control capability. This concept is based on a physically dispersed, functionally distributed architecture in which every tactical air operations module (TAOM) has the capability to perform a wide range of command and control functions including: force management and control, air surveillance management and control, surface surveillance management and control, and operations intelligence management and control. In concept, every module should be able to perform all functions and assume another module's function if required. Therefore, an air defense TAOM could be reinitiated to perform a GACC function in seconds. This architecture would work on the same concept of a multi-role fighter that could be quickly "reroled" from a defensive to offensive mission. (14:--)

With the introduction of JSTARS, a whole new set of capabilities are available that take advantage of a new sensor. The raw sensor data could be processed on the E-8A aircraft and transmitted down to a TAOM node via a joint tactical information distribution system (JTIDS) link using a Class 2 JTIDS terminal. With this information, operators and decision makers would be able to "see" the threat. Using standard symbology to display the current ground situation, the operator would be able to direct strike aircraft to the target. Decision makers would use the same

displays to make real time decisions on highest threat targets.

MCE P3I: Capability to Support AirLand Battle Doctrine

The introduction of JSTARS will revolutionize air-land warfare and the employment of TACAIR in support of the ground commander. However, just possessing the capability to detect ground targets in real time is only part of the AirLand Battle challenge. In order to maximize the JSTARS capabilities, the "command" and "control" elements in the C3I process must have access to the information, and be able to make decisions and take actions based on the JSTARS enemy ground situation displays. What this means in operational terms is that the operational value of the JSTARS platform will be significantly reduced if the JSTARS ground threat data is not available to decision makers and operators in the Air Force C3I network -- the tactical air control system.

The JSTARS threat data will have a wide range of applications at both the tactical and operational level. The tactical data will be used at the execution level to accomplish an activity -- control aircraft. The information will be used at the operational level to conduct target analysis and develop battle plans. In AirLand Battle terms this means using the data to posture forces and facilitate attacks against ground targets. However, the information must first get to the command and execution level in order to have maximum operational value. This is where the ground interface becomes so important.

A modular architecture using modular control equipment

as the baseline would have several advantages in AirLand Battle application. This approach would enable the Air Force to field a complete and integrated system. In addition, a hardware and software capability that could be functionally adapted to a ground or air attack control capability would provide tremendous deployment and employment operational flexibility and could be easily integrated into air/ground operations. This inherent flexibility would provide a ground attack control capability that mirrors the air defense structure. A ground attack control capable modular control equipment element colocated with the TACC would provide decision makers with near real time data on which to base tactical decisions.

Using this concept, application could be extended to the air support operations center (ASOC). Based on the statement of operational need to upgrade the ASOC, the functionally modular approach could support the GACC and ASOC function. A regional GACC could be colocated with the TACC and manage a large area of operation while a GACC capable air support operations center could be designated as the area manager for Corps level operations.

In summary, a modular control equipment based P3I approach to fielding a ground attack control capability does provide the capability to take advantage of the JSTARS data. The modular approach to a functionally designed tactical air control system provides increase effectiveness in planning and controlling attacks against ground targets. Today, air interdiction and battlefield air interdiction is primarily a procedural process. Attack planning at the

division level is focused about 24-48 hours in advance and about 48-96 hours for the Corps. Using the concept and capability described above, the Air Force could develop an AI/BAI scheme much like the system used for close air support (CAS) today. Some AI/BAI would be preplanned, and the capability would exist to strike "immediate" targets that were detected after the air tasking order was sent out. This flexibility could be employed down to the ASOC level. In addition, the Air Force could field a GACC type capability at the division, brigade, and battalion level. This would facilitate and enhance AI/BAI support to the Army.

MCE P3I: Cost to Develop Capability

Cost figures to develop the capability just described are very soft. The approximate cost of one MCE is \$6 million dollars. If the HQ TAC concept of employment is used (locate three tactical air operations modules with each of the two CONUS based TACCs) the total production cost to purchase six tactical air control modules would be \$36 million. Research and development cost for a GACC would add another \$6 million. Therefore, the total cost would be approximately \$42 million. This does not include a capability for USAFE and PACAF.

Contingency Tactical Air Control System (TACS) Automated Planning System (CTAPS)

Battle information, changes in plans, and information on friendly and hostile aircraft positions flow up and down the tactical air control system structure. However, sortie allocation decisions, and development of the air tasking

order take place at the tactical air control center (TACC). As such, the TACC is the brain of the TACS and serves to direct the activities of the subordinate elements. However, modernization at the TACC level has been slow and only recently has a comprehensive program been undertaken to help automate and speed up the two-way flow of information between the TACC and subordinate elements.

This initiative, termed the contingency tactical air control system automated planning system (CTAPS) is designed to electronically tie the computers of the air support operations center, wing operations center, and flying squadrons together. This interconnectivity will eliminate the need to call or use a runner to exchange information. The program was recently expanded to include some other decision aids for tactical battle management. One of the enhancements has the potential to upgrade capabilities in the ground attack control area.

This portion of the study will look at the CTAPS modernization program. CTAPS is designed to integrate off-the-shelf equipment, rapidly provide integrated prototypes to the field, and procure follow-on equipment through industry.

CTAPS: Effectiveness of the System

The objective of CTAPS is to develop a capability to provide decision makers with automated targeting, collection management, situation analysis, and improved air tasking order (ATO) development and execution tools. The main enhancement from the CTAPS program is the enemy situation correlation element (ENSCE). ENSCE, along with its Army

equivalent, the all source analysis system (ASAS), will provide a common picture to Air Force and Army tactical commanders.

Currently, large amounts of intelligence data received from sensor systems must be manually correlated by intelligence analysts at the command level -- the TACC. Commanders are unable to take full advantage of near real time intelligence data from such sources as the tactical ELINT processor (TEP), SENIOR TROUPE, the joint services imagery processing system, and in the future the JSTARS. The CTAPS will provide a capability to fuse and correlate different sensor information. ENSCE could also provide intelligence and target nomination and updates for a ground attack control capability.

The ground attack control capability derived from this new system could be structured in much the same way the procedural system is employed today. Workstations located in the TACC would receive x - y coordinate data on enemy targets from the JSTARS E-8A. This information would be used to develop the overall air situation display. Enemy target data would also be correlated with other intelligence sources and used to develop a data base upon which to conduct target planning. This composite ground situation display would be developed in near real time and could provide a composite data base to aid in decision making. Using data retrieval procedures, decision makers would have access to information to develop the air tasking order. The data base could also interface with the wing operations center and flying squadrons to help facilitate the timely

dissemination of the air tasking order.

To compliment this system, the Air Force would use display scopes and a data base on board the JSTARS to display the real time ground situation. This information would be centralized into an operations and control unit on the aircraft. Processed data would be forwarded to the CTAPS for integration with other intelligence data. Hosting ENSCE and JSTARS data within the CTAPS architecture would provide the needed operations and intelligence integration at the tactical air control center.

CTAPS: Capability to Support AirLand Battle Doctrine

The CTAPS program will for the first time, provide tactical air and ground commanders virtually the same information on the battlefield situation. Using ENSCE, and the Army's all source analysis system, planners will have the same information upon which to make target attack recommendations. This commonality will greatly enhance battlefield interoperability down to and including operations at the air support operations center.

This system could also provide a capability to better plan and execute air interdiction and battlefield air interdiction missions. JSTARS data could be quickly forwarded to the TACC where it would be fused with other sensor data and folded into an air tasking order that establishes priorities for the ground operation over the next twenty-four to seventy-two hours. The mission execution would still be primarily procedural; however, air defense control units would be available to provide flight follow assistance until the attack aircraft crossed the

Forward line of troops (FLOT) and began the attack profile. In addition, CTAPS workstations would have the capability to display near real time ground target data in x - y coordinate format.

The tactical environment beyond the FLOT will be even more diverse and complex than the airspace over friendly territory. For this reason, attack aircraft may elect or prefer not to operate in a close control environment. This is where the CTAPS offers advantages over a ground attack control capability that employs close control tactics. With CTAPS, target coordinates will be provided in the air tasking order and attack aircraft pilots will plan the attack based on this data. If target data changed before takeoff or enroute to the target, operators onboard the JSTARS could still contact the attack aircraft and update the target data. In addition, the same capability would be available at the TACC. Using these procedural control tactics during ingress and egress would add flexibility and survivability in a high threat, fluid battle environment.

CTAPS: Cost to Develop Capability

The Tactical Air Command is working with the Idaho National Engineering Laboratory (INEL), Department of Energy to develop a CTAPS capability. SM-ALC has been identified for follow-on production contracting after prototyping and establishment of system life cycle support. In FY 88, funding cuts resulted in loss of procurement dollars for ENSCE hardware. Currently HQ TAC is investigating the feasibility of hosting ENSCE on hardware being procured under CTAPS. (13:--)

The estimated cost to develop a ground attack control capability within the CTAPS architecture is approximately \$7.2 million. Each CONUS based TACC would have the capability; however, the cost does not include a ground attack control capability at the ASOC. Implementing GACC at the ASOC level is feasible, based on the ASOC SON, but the cost is unknown.

Joint Army & Air Force Procurement Program

The Army is involved in a sole source effort with Motorola to develop ground based modules that will receive, process, and disseminate radar data received from the JSTARS E-8A aircraft. This portion of the study will examine what benefits would be derived from a joint Air Force - Army purchase initiative that takes advantage of the work that has been ongoing with the Motorola ground station module (GSM). A joint development venture is not a new approach to TACS modernization. The modular control equipment currently being developed for the air defense structure is a joint service initiative between the U.S. Marines and the Air Force.

Joint Venture: Effectiveness of the System

The Army and Air Force have a different approach on how JSTARS data should be used. This conceptual difference has resulted in a different proposed architecture for each service's ground interface. The Army plans to send raw radar data to ground stations over a digital data link. This radar data will be displayed at a ground station module and used for targeting. In contrast, the Air Force plans to incorporate control scopes and a data base located aboard

the JSTARS aircraft. Raw radar data will be processed in the aircraft and command and control information forwarded to a ground station via a joint tactical information distribution system (JTIDS) link using a Class 2 JTIDS terminal. This different approach to using the JSTARS data stems from different operational requirements in each service's command and control system.

Regardless of which approach is used, the operator and decision maker will be able to "see" the ground situation display in real time. The Army approach allows the operator to see the actual raw radar return from the target. This raw radar will be received at a ground station module and then processed for dissemination to other command and control nodes. The Air Force approach differs in where the raw radar data is processed. The Air Force prefers to process the data aboard the E-8A and then use a standardized message format system to transmit x - y coordinate data that depicts the location of ground targets. This conceptual difference would have to be resolved before the two services could enter into a joint procurement venture. If the Air Force is unwilling to adopt the Army approach a joint initiative might not be feasible.

Joint Venture: Capability to Support AirLand Battle

The Air Force would have difficulty incorporating raw radar data into the tactical air control system structure for fusion with other C3I data. The entire Air Force air defense structure is based on a standardized M-series message format for the exchange of position data. The modular control equipment will incorporate the M-series

message format and this is the approved interface architecture currently used between the E-3 airborne early warning aircraft and ground based air defense elements. To pursue a different architecture with JSTARS would present a totally new interoperability challenge for the Air Force.

The Air Force may encounter other integration problems if this approach is used. The ground station modules being developed by the Army are a two-operator module. Each of these modules will receive raw radar directly from the E-8A, process the data, and forward it to other nodes. This architecture would require the Air Force to employ ground processing modules and other control modules that might not be required if the data were processed aboard the JSTARS. This approach would reduce flexibility and present potential bottlenecks in information flow. The potential exists for the distributed data to be slower in reaching the command level where it must be integrated with other intelligence data.

In summary, the issues that have been presented here would have an impact on air-land integration if they could not be resolved. The issues are not insurmountable; however, new operational procedures would have to be worked out to incorporate the new system architecture. Also, a decision would have to be made concerning the present Air Force initiative to develop a centralized operations and control unit aboard the JSTARS. If this Air Force capability were deleted it would reduce some of the flexibility currently planned for JSTARS. The U.S. would lose the capability to deploy anywhere in the world and be able to

see the ground situation from aboard the JSTARS aircraft.

Joint Venture: Cost to Develop Capability

The cost involved in a joint initiative is unknown. The Army is already on contract with Motorola to develop a ground station module (GSM) and a downsized version of the GSM with improved transportability. In addition, work is ongoing to develop a surveillance and control data link, a display generator system, and color monitors for the ground stations. The total cost of the entire project is approximately \$215 million. The exact number of GSMs and downsized modules required to support Air Force operational requirements would have to be determined after a concept of operation for the new architecture is determined.

Proposed Solution for Achieving a Ground Attack Control Capability

This study has shown that a ground attack control capability will significantly enhance the present tactical air control system capability to conduct effective command and control of TACAIR operations in support of AirLand Battle doctrine. With this thesis established, three options were examined that have the potential to provide a ground attack control capability for the Air Force.

An analysis of the three options using the criteria of effectiveness, capability to support AirLand Battle, and cost indicate that all options would provide some degree of capability. However, the option that provides the optimum support to the air and ground operation is the contingency tactical air control system automated planning system (CTAPS).

The contingency tactical air control system automated planning system (CTAPS) provides the best capability to support air interdiction and battlefield air interdiction missions on the modern battlefield at the lowest cost. The system provides a capability to field a ground attack control capability near term as part of the tactical air control center automation initiative that is ongoing. This is important, considering the time involved in trying to modernize the air defense structure. Using the CTAPS program, the Air Force will have the capability to receive ground target data from the TARS, and display processed information at ground workstations in the tactical air control center. This near real time data could be fused with target intelligence provided by the enemy situation correlation element to provide an accurate ground order of battle display. This information could also be used to assist Army planners in developing a second echelon ground attack plan that looks seventy-two to ninety hours into the future.

In summary, the Air Force is tasked to provide air interdiction (AI) and battlefield air interdiction (BAI) support to the ground commander. The contingency tactical air control system automated planning system (CTAPS) provides the capability to enhance this support and improve Air Force support on the AirLand Battlefield. CTAPS may also have future ground attack control capability application at the air support operations center level. This capability could totally revolutionize how the Air Force and Army plan and execute AI/BAI missions. In addition,

although this study has focused on a CONUS based TACS structure, CTAPS that incorporates a ground attack control capability, would have worldwide application in any theater of operation. Finally, a CTAPS/GACC can be fielded near term and at the lower cost of the three options examined.

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